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Enhancing Performance Under Stress by Information About Its Expected Duration

Shlomo Breznitz

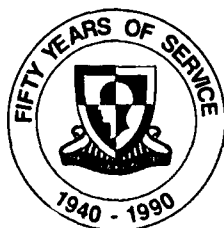
University of Haifa

for

**Contracting Officer's Representative
Milton S. Katz**

**Basic Research
Michael Kaplan, Director**

July 1990



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ENHANCING PERFORMANCE UNDER STRESS BY INFORMATION ABOUT ITS
EXPECTED DURATION--SECOND ANNUAL REPORT

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INTRODUCTION

This study attempts to explicate the "tour of duty" phenomenon, that has been found effective in promoting endurance in a variety of combat settings. The basic premise which serves as the rationale for this effort is the idea that knowing when a particularly stressful ordeal will terminate may significantly augment our capacity to mobilize coping resources. The particular research strategy rests on the utilization of a specific laboratory paradigm, namely, the Cold Pressor Test (CPT). At the same time, however, the specific research questions are formulated in a manner which makes them easily translatable into real-life field conditions. In addition, as stated in the contract, initial steps will be made to actually carry out a pilot study with soldiers in order to test the practical applicability of some of the experimental findings.

Since the studies in this report consist of an integrated research program, before describing the work performed during the second year, it is useful to summarize the main ground covered during the first year of research (Breznitz, 1988; 1989).

The first, and most important finding was that the "tour of duty" phenomenon could be demonstrated within the controlled environment of the experimental laboratory. Thus, using the (CPT), we found that subjects who did not have any information about the duration of their ordeal, were less successful in completing the task of holding their hand in the ice-cold water for a full four minutes. By comparison, subjects who were told in advance that the CPT consists of four minutes, and in addition were given a clock which monitored the time, were better able to endure the pain. Moreover, essentially similar results could be documented in the second task, that of pressing the dynamometer, a task which called for major physical exertion. On both of these tasks the advantage of full information over no information was clearly significant. Subjects who received invalid information at the start, either false-short or false-long information with subsequent correction, fell between these two extreme groups. This indicates that whatever advantages subjects in the false-short condition had prior to the information change, were compensated for later by the disadvantage of hearing that the task was longer than originally expected. Essentially the same logic applies to the second information change condition, namely, the initial disadvantage of anticipating a very long task, were offset to some extent by the advantages of learning that the task was in fact shorter. It is of some interest to note that the disadvantages in both cases were apparently more potent than the advantages, otherwise it would be hard to explain why

the overall performance of these two groups fell short of the full information group.

Although the two stressors, the Dynamometer Test and the Cold Pressor Test are very different in terms of the quality of the stress itself, as well as the type of coping they call for, it is important to note that subjects who successfully completed one of them had a much better chance of completing the other one as well. This may indicate either individual differences in terms of commitment to the experimental procedure, or the effects of success and failure on the first task on subsequent endurance. Such a "positive recency effect" would, of course, be anticipated to be much stronger when the two consecutive tasks are more similar.

The relationships between endurance and psychophysiological indicators of stress are of special interest. Thus, the onset of the stressor was always characterized by a significant increase in heart-rate. More important, however, is the finding that heart-rate can give us some clue about the perceived difficulty of the task in the various information conditions. The finding that the timing of the maximal heart-rate was systematically related to information about the anticipated duration of the task is particularly promising. Thus, subjects who expected the Cold Pressor Test to last five minutes reached the maximal heart-rate earlier than those waiting for four minutes, who in turn reached their peak heart-rate earlier than those who thought that the task will last for three minutes only. In other words, the longer the anticipated duration, the more stressful the task, with the consequence of earlier onset of what might indicate a "crisis" experienced by the subjects. It is therefore not surprising that subjects who could not successfully finish the task reached the point of maximal heart-rate earlier than those who did, indicating that for them the task was more difficult.

Elevations in heart-rate are by no means negative indicators, as suggested by the finding that, on the whole, subjects who successfully completed the task exhibited higher maximal heart-rates than those who were unable to endure the task until the end. This is in line with the argument that subjects need to mobilize their energy in order to better cope with the stress.

On the level of individual differences, there was a potentially promising indication that denial of stress reduces endurance, and that external locus of control enhances performance.

ENDURANCE OF TWO CONSECUTIVE SIMILAR TASKS

The main reason for adding the Dynamometer Task that was used in all of the five experimental groups tested so far, was to overcome some possible limitations of a single

stressor procedure. Thus, it was important to discover whether the role of information, or its absence, in enhancing or reducing endurance, is basically the same in the two different types of stressors. The results so far indicate that such is the case, contributing to our confidence in the generalizability of our findings. The differences between the Dynamometer Task and the Cold Pressor Test are several: One calls for physical exertion, whereas the other for the ability to endure pain. One becomes more and more difficult as time goes on, whereas in the case of the Cold Pressor Test, enduring the initial immersion of hand into the ice-cold water may be a major problem. The Dynamometer Task is much shorter, and much more intensive, and this poses some limits on the amount of within-task manipulations that can be tested.

A principal component of our research strategy is to move from relatively simple designs into more complex ones. Thus, it is important to be able to utilize within-subject designs, particularly in view of our interest in the role of experience on subsequent endurance of similar tasks. Consequently, during the first part of the second year of study, we have embarked upon a systematic investigation of the effects of repeated exposure to essentially the same stressor, namely, the Cold Pressor Test.

A necessary stage in our attempts to advance this methodology, consists of studying the effects of hand dominance and order effects on overall endurance. Such data are necessary in order to provide a sufficiently broad data base that will allow subsequent more complicated research designs, without undue worry about these obviously relevant factors which need to be controlled.

Experimental design

Two groups of subjects were tested with the CPT twice. The dominant hand first group (DF) started with the dominant hand in the ice-cold water, followed by a five-minute period of relaxation, and a second CPT using the non-dominant hand. In the non-dominant hand first condition (Group NF) the order of the hands was reversed. Subjects in both groups, on both trials, were told to keep their hand in the water until told to remove it. Thus, this was similar to the condition of the No Information Group as described in the First Annual Report. It was thought important to utilize this particular informational condition in order to reduce effects of knowledge of time from the first task to anticipation in the second one. As in the original No Information Group, there were no clocks and subjects' watches were removed prior to the start of the experiment. Table 1 describes the experimental design.

Insert Table 1 about here

Subjects

Subjects were 42 female students at the University of Haifa who were paid for participating in the experiment. They were randomly distributed between the two groups. All subjects had right hand dominance.

Results and Discussion

Table 2 presents the percentage of subjects in each group and in each condition that were able to endure the CPT for four minutes, which, as in our previous studies, is our external criterion for success.

Insert Table 2 about here

Table 2 indicates that there is a small, though statistically insignificant advantage to the non-dominant hand. It is conceivable that there is a slight tendency due to a higher pain sensitivity in the dominant hand, but this requires further explicit study. In addition, the second trial appears to be less stressful than the first one. That effect also does not reach statistical significance.

These results reduce some of the problems associated with exposure to repeated stressors by the same subjects. Subsequent research as planned in the contract, need not put undue premium on order effects, hand effects and effects of experience.

The finding that the chances of successfully finishing the task on the second trial are somewhat greater than on the first one, has several interesting psychological ramifications. Foremost among them relates to the influence of perceived success on subsequent endurance. In other words, having experienced success on the first trial may have significant positive effects on endurance on a second similar task. This is not unlike the training of competence and effectiveness.

In order to gain additional insight into this issue, the relationship between success and failure on the two tasks was tested. The results are clearcut: All five subjects who successfully completed the first task did so also on the second task. Two additional subjects that did not succeed in the first task, did so on the second one. The practical potential of this finding is quite far-reaching. Thus, for instance, one could pace the difficulty of a set of stressors systematically in such a

Table 1: Experimental design for Groups DF & NF.

	Trial 1	Trial 2
Group DF	R Hand	L Hand
Group NF	L Hand	R Hand

Table 2: Successful completion according to groups and trials. (Percentages)

	Trial 1	Trial 2
Group DF	10	19
Group NF	14	14

minute, and the amount of subsequent information change is also longer by one full minute.

Group 7 consisted of subjects who were given more extreme false-long information, namely, that they have to endure the Cold Pressor Test for six minutes. Prior to the expiration of two minutes, this was subsequently reduced by two minutes to ensure that all our subjects ultimately expect a four minute duration.

Following the first (CPT), subjects were given two minutes for recovery, followed by a second (CPT). This consisted of reversing the information conditions of Groups 6 and 7, respectively. Thus, subjects in Group 6 received, on the second trial, false-long information with subsequent reduction, and subjects in Group 7 false-short information with subsequent increase.

Table 3 describes the experimental design according to groups and information conditions.

Insert Table 3 about here

The specific design employed makes it thus possible to utilize comparisons between Groups 6 and 7, as well as within each group between the first and second task.

Dependent variables

As in the previous experiments, our main focus consists of the behavioral measures of endurance. Therefore, the frequency of subjects carrying out the task to its successful completion, as well as the exact time of "giving up" was measured. Heart-rate was taken continuously throughout the entire experimental sequence. Subjective reports of stress, as well as responses to direct questions pertaining to the various features of the experiment, were secured shortly after the termination of the experiment. In addition, as in earlier experiments, a short battery including Beck's Hopelessness Scale, as well as the Locus of Control, and the Denial Scales was also given.

Subjects and procedure

All subjects were male students at the University of Haifa. They were recruited from the entire body of students on a voluntary basis. A fee of IS20.00 was offered for participation. All subjects were tested individually.

Protection of subjects. Only subjects who were in perfect health could participate. At the onset, as well as after learning the purpose of the study, subjects were reminded of their privilege to terminate the experiment at any moment, without prejudicing their remuneration. Only after obtaining a signed informed consent form did the

There were 18 subjects in Group 5, and as in Group 4, all were male students at the University of Haifa. Whereas in Group 4, 56% of the subjects could keep their hand in the water for four minutes, the percentage in Group 5 was 67%. Although this difference is not statistically significant, it suggests that due to prior experience of the Group 4 subjects, they apparently did not trust the three minute goal from the onset. This could partially explain their relatively reduced performance. The absence of a statistically significant difference can also relate to the fact that the two consecutive tasks are not very similar to each other, thus reducing the learning effect from the first to the second. Further research needs to be done in order to analyze the effects of false promises on two exactly identical stressful tasks.

EXTENSION OF THE RESEARCH DIMENSIONS

With the exception of Groups 1 and 2, that compared no information with full information about duration of the stressful task, the different experimental conditions studied so far sample only a narrow band of the dimensions involved. Thus, in Groups 2, 3, 4 and 5 the expected duration of the Cold Pressor Test varies between 3 minutes to 5 minutes only. For the same reason, change in information, whether encouraging or discouraging, was never more than one minute. The findings concerning these factors must, therefore, be viewed in the context of the above limitation. In order to provide a broader data base, it was thought worthwhile to add yet two additional experimental conditions. The main rationale for the choice of the parameters involved was to broaden the spectrum parametrically, to more extreme conditions. Although these two additional experiments do not appear in the original contract, their potential contribution to the understanding of the data so far, warranted this extra effort.

Furthermore, in view of the fact that within-subject designs using the Cold Pressor Test are relatively immune from order effects and hand effects, we could now utilize the combination of both between- and within-subject designs. Considering the contribution of individual differences within each experimental condition, such a combined design greatly increases the power of our analysis.

Method

A new, more extreme false-short condition consisted of subjects that were asked to endure the Cold Pressor Test for two minutes only, with a subsequent correction for two additional minutes. Thus, Group 6 is more extreme than Groups 4 and 5 on two levels: In the first place, the expected duration of the stressor is shorter by one full

way that subjects will experience success in the early stages, thus increasing their chances of succeeding on the more stressful tasks as well.

Experience, however, is a package deal, and it is important to find out what happens to those subjects that fall on the first task. In order to test the impact of failure on subsequent performance, the data on subjects who did not endure the first task for four minutes was analyzed separately. Out of 37 such subjects, 24 kept their hand immersed, on the second trial for a shorter duration than on the first trial. Three kept it for equal times, and ten longer than before. These results suggest that subjects who did not succeed on the first task are twice as likely to endure less on the second one.

The effect of false promise on endurance

We now approach an issue of central importance. Since our research program consists of situations where there is change in information concerning the duration of the stressful task, such information change may significantly reduce the credibility of similar information on a second subsequent task. In more practical terms, if it were known that certain types of information which is not veridical is effective in enhancing endurance, the question still remains whether this is a one-time possibility only, and to what extent is its subsequent usage jeopardized. This ought to be viewed in the context of research on false alarms as studied by Breznitz, 1984. Thus, in one of the groups studied during the first year of research, namely, Group 3, subjects were initially given longer durations than they were subsequently required to endure. At some point during the task itself, this was then corrected, producing the impact of encouraging disconfirmation. Such a manipulation is in fact very much in line with the formulations about the false alarm effect, and it stands to reason that there is a certain amount of credibility loss involved. By contrast, Group 4, as described in the First Annual Report, was given initially shorter durations, with subsequent discouraging change. Psychologically, this corresponds to producing false promises which are in a way the mirror image of false alarms. Specifically, after realizing (as in Group 4) that the Dynamometer Task was prolonged, they could expect that the information about the duration of the Cold Pressor Test is also not credible.

In order to test for this effect, a special experiment, utilizing a separate group (Group 5) was carried out. In this group, the Dynamometer Task was given for 70 seconds (without any change en route), followed by CPT instructions for three minutes with subsequent change to four. By comparing the results of Group 5 with those of Group 4, the impact of prior change on the CPT could be ascertained.

Table 3: Experimental design for Groups 6 & 7.

	Trial 1	Trial 2
Group 6	2 + 2	6 - 2
Group 7	6 - 2	2 + 2

Table 4: Analysis of variance of endurance in Groups 6 & 7.

Group	Mean	SD	Source	SS	D.F.	F	Sig.
6	219.6	48.9	Between	25,493	1	4.98	P<.05
7	168.3	91.3					

experiment proper begin. (See Appendix D of the First Annual Report for the exact forms used).

CPT is one of the best researched stressors, and while obviously painful, does not produce any harm. The durations used in this study, as well as the water temperature (1-2 degrees Centigrade), are well within the range documented harmless.

Laboratory setup. Two experimenters were used for the testing of each subject. The laboratories consisted of two adjacent rooms with a one-way mirror between them. The lighting in the control room (hosting the experimenters and the instruments) was always weaker than in the subject room, allowing the observation of the subject without his awareness. Upon arrival, the subject was greeted by one of the experimenters, and seated in the subject room. After a series of questions concerning his health status, the subject was asked to give his signed consent to participate, and to agree not to discuss the details of the experiment with anyone outside the laboratory. He was then attached to the polygraph (Grass, 7D) in order to obtain continuous readings of heart-rate. The electrode consisted of a photoelectric cell (Type TTY) which was attached to the subject's right earlobe. This attachment was found less sensitive to artifacts related to minor movement, and at the same time allowed the free use of both hands. Immediately after finding the quality of the heart-rate reading satisfactory, the subject was given the 'Baseline Instructions'. In order to ensure reliability, all instructions were recorded in advance, using an FM audio recorder.

The 'Baseline Instructions' were the same for all subjects, irrespective of their subsequent experimental treatment: "For your participation in the experiment you will receive a basic sum of IS20.00. We are interested to read your lowest heart-rate, so please sit quietly for a few minutes, and try to relax as much as possible."

Next followed two minutes of 'Baseline' recording, followed by the first task, according to the specific information condition to which a particular subject was allocated on a random basis. The instructions were: "Don't do anything until you get specific instruction to begin. In a short while you will be asked to immerse your left hand in a bucket full of ice and water, and keep it there for two (or six) minutes. At the moment that you immerse your hand and press the bottom of the bucket, the clock in front of you will start. The ice-water is very cold, but not dangerous. I repeat, you have to keep your hand immersed for two minutes, and press the bottom of the bucket all the time. Remember, you may terminate the experiment at any moment. If you are able to finish the task you will receive IS10.00 in addition to your previous earnings. START!"

In the false-short condition, Group 6, exactly after one minute and 45 seconds, the following correction was made via the intercom: "Pay attention! The time was prolonged from two to four minutes, and the conditions remain as before." In the false-long condition, Group 7, the instructions read: "Pay attention! The time was shortened from six to four minutes. All other conditions remain the same."

Following the termination of the Cold Pressor Test (either by the subject or after four minutes), subjects were told to finish and remove their hand, and the experimenter entered the room to wipe the subject's hand with a towel. He was then told: "You can now relax and try not to move the right hand which has the electrodes attached." The subject then rested for five full minutes and filled out questions pertaining to the first part of the experiment. At the end of this phase he was told there is another part to the experiment and given the appropriate information about the second Cold Pressor Test. This, too, was terminated after four minutes after which time the subject was given five minutes to rest, filled out the questionnaires, given the remuneration, thanked for his participation and reminded of his promise not to discuss the experiment with anybody.

Results and discussion

The total sample consisted of 41 subjects, 21 in Group 6 and 20 in Group 7. Due to some technical difficulties, such as occasional noise in the recording of the heart-rate, not all subjects produced the entire spectrum of data collected.

The first and the most important question relates to the successful completion of the task. The results on the first trial indicate that 17 out of 21 subjects, i.e., 81%, completed the task successfully and kept their hand in the ice-cold water for four minutes. In Group 7, by comparison, only 10 out of 20 subjects, i.e., 50%, were able to keep their hand in the ice for four minutes. This difference is statistically significant ($\chi^2=4.36$, D.F.=1, $p<.05$). This finding is in line with our expectation that when the initial expected duration of a stressful task is short, subjects are better able to endure it. Analyzing the actual duration of endurance in the two groups, we find essentially the same results. Thus, in Group 6 the mean duration was 219.6 seconds, whereas in Group 7 it was only 168.3. Table 4 presents the analysis of variance.

Insert Table 4 about here

Moving now to the within-subject design, Tables 5 and 6 present the distribution of successful completion of the two tasks by subjects in Groups 6 and 7, correspondingly.

Insert Tables 5 and 6 about here-

Table 5 indicates that without exception, all subjects that successfully completed the first stressful task were capable of doing so on the second trial as well. This finding lends further support to the notion that positive experience with a stressful task enhances probability of success on a second subsequent task, as well as the opposite. In other words, the few subjects that were unable to complete the task successfully and experienced failure, endured less on the second trial as well. Thus, the positive effects of false-short information that produced high frequency of successful completion paved the way for longer endurance even under the second, less favorable conditions of false-long information.

The picture in Table 6 is somewhat more complex. Firstly, the principle of successful initial completion was again demonstrated by the fact that 9 out of 10 subjects who completed the first task successfully were able to do so on the second one as well. In addition, however, five new subjects that could not finish the first task were able to do so on the second one. This is in line with the main effect found between Groups 6 and 7 on the first trial. Thus, in Group 7 the second condition of false-short is in fact psychologically easier than the first one. This 20% increase in successful completion in Group 7 on the second trial is quite dramatic, in view of the fact that it has to overcome the effects of prior experience. Out of 10 subjects who failed the first task, four were able to profit from the psychological benefit of false-short information to the extent that they overcame their experience with prior failure.

This particular analysis is further complicated because unlike in the other groups that were given the Cold Pressor Test twice on two consecutive occasions, in this case there was information change, and thus a certain amount of credibility loss. It is not clear what was the precise impact of the discouraging addition of two more minutes in Group 6 on the expectations of those subjects when they were told on the second trial that they have to endure the task for six full minutes. They might have anticipated that this is not the last that they heard about the duration and it might change either way. Once again we need more precise knowledge of the effects of false promises. Needless to say, in Group 7 the initial false alarm experience may have

Table 5: Success and failure by trials, Group 6.

Trial 1	Trial 2	
	Success	Failure
Success	17	0
Failure	0	3

Table 6: Success and failure by trials, Group 7.

Trial 1	Trial 2	
	Success	Failure
Success	9	1
Failure	5	3

14

produced similar distortions in expectations concerning the validity of the initial information of the second trial.

To sum up this particular part of our analysis, the main finding justified our attempts to extend our initial experimental manipulations by using more extreme information change conditions. Thus, whereas there were no significant differences in endurance between Groups 3 and 4, in the more extreme case of Groups 6 and 7 the psychological impact of the expected duration of a stressor could be demonstrated.

The present experiment allows not only the extension of our findings to a wider spectrum of the dimensions involved, but also the testing of the robustness of some of the earlier findings. Two such findings of potentially important practical implications, as well as of theoretical interest, concern the relationship between maximal heart-rate and endurance. As already stated, maximal heart-rate could be viewed as an indicator of crisis. Endurance in the earlier experimental groups was positively related to the ability to mobilize energy as indicated by the amplitude of maximal heart-rate, as well by its later onset. This was stated as a more general principle, cutting across the specific information conditions within the various groups. In order to test whether this finding is replicated in our present study, we computed the correlation between endurance and both the amplitude of maximal heart-rate as well as its temporal position following the beginning of the stressful task. This calculation was done for both groups together, over both trials. The results are very promising: The correlation between endurance on the Cold Pressor Test and the amplitude of the maximal heart-rate was found to be $r=0.41$ ($p<.001$). This, again, lends support to the notion that intensity of psychophysiological arousal is positively related to endurance. This is of special interest in this particular context, because unlike in the Dynamometer Task, coping with the Cold Pressor Test does not call for direct exertion of effort. And yet, it appears that the ability to mobilize the autonomic nervous system is a positive factor. In order to control for possible artifacts due to an artificial ceiling effect of four minutes, this calculation, as well as the subsequent one was carried out only on subjects who did not endure the Cold Pressor Test for the entire four minutes.

Even of possibly greater potential importance, however, is the relationship between endurance and the timing of the maximal heart-rate. Here the correlation was found to be $r=0.29$ ($p<.05$). In other words, the later the crisis arrived, the longer the subjects could endure the stressful task. Both of these findings replicate our earlier data from the initial four groups studied during the first year. The replicability of this phenomenon adds some confidence to

the notion that maximal heart-rate can be used as an important indicator of a psychological or physical crisis encountered by the subject.

Our earlier experiments indicated that there is a negative relationship between the tendency to engage in denial on the one hand and endurance of the Cold Pressor Test on the other. It was argued that denial as an individual difference variable may produce false expectations about the difficulty of the stressful task, expectations that are then subsequently shattered by the painful experience. Stated differently, it could well be that in stress situations which are relatively intense, and provide reality testing by virtue of their presence, the tendency to engage in denial will have negative consequences for endurance. The present experiment makes it possible to test the reliability of this finding on yet another group of subjects that were exposed to somewhat different informational conditions. Once again, the results turned out to be robust. The Pearson correlation between denial and endurance for Groups 6 and 7 was $r = -.42$ ($p < .05$). In other words, denial reduced endurance.

THE ROLE OF CONTROL IN ENDURANCE

Stressful tasks differ in the amount of personal control over the duration of the ordeal. In many military situations soldiers have to endure hardships opposed by external circumstances, or by order from their superiors. In those instances the duration of the stress is entirely out of their control. Nevertheless, in some cases soldiers can be the sole judges of how much they can endure. In a variety of situations it is not clear whether endurance is better under conditions of external control, i.e., out of the domain of a person's own decision, or when the subjects are asked to "do their best". This issue is related to the problem of motivation and performance as influenced by "goal setting". Duration of enduring a stressful task may, in principle, be considered a case in which the goal is to persist on a task for a given period of time. In a recent review of the evidence, Locke (1981) writes: "Results from a review of laboratory and field studies on the effects of goal setting on performance show that in 90% of the studies, specific and challenging goals led to higher performance than easy goals, "do your best" goals, or no goals." (p. 125).

Of most immediate concern in any attempt to understand information factors affecting endurance, is direct comparison between an external source of authority, and the "do your best" condition. Within the context of our experimental program, data on this issue can provide important clues about the specific conditions when endurance

may be enhanced by the type of information most effective under the circumstances. Such a study is important in yet another respect, namely, it puts into direct behavioral test the prevalent notions about the overall advantages of control coping with stress.

A priori it is not clear whether control will increase or decrease endurance of certain types of stressors. Lazarus and Folkman (1984), in their comprehensive treatment of the topic are clearly aware of its complexity: "The relationship between situational control appraisals and appraisals of threat and challenge is complex. Most theory and research on the the relationship between control and stress is based on the assumption that having control is stress-reducing. Yet there are studies indicating that the obverse is sometimes true (For examples see reviews by Averill, 1973; Thompson, 1981)." (p. 72).

Method

Two groups of subjects, Group 8 and Group 9, respectively, participated in a study employing once again the combination of a between and within-subject design. Each had to endure the Cold Pressor Test twice. Subjects in Group 8 started by putting their left hand into the ice-cold water and were told to keep it there: as long as you can. On the second trial they used their right hand and were told to keep it in the ice-cold water: until we tell you to remove it. In Group 9, the conditions were reversed. Table 7 describes the specific experimental design.

Insert Table 7 about here

Since subjects in this experiment used both of their hands consecutively, it was unfeasible to obtain psychophysiological recordings, normally taken from the other hand. The central dependent variables in this study were, however, essentially the same as in previous groups, namely, the behavioral endurance of the Cold Pressor Test.

Subjects and procedure

All subjects in this research were male students at the University of Haifa. They were recruited from the entire body of students on a voluntary basis. A fee of IS20.00 was offered for participation. All subjects were tested individually. All in all there were 42 subjects that were

between the two experimental

Table 7: Experimental design for groups 8 & 9.

	Trial 1	Trial 2
Group 8	Control	No Control
Group 9	No Control	Control

Table 8: Success and Failure by trials, Group 8.

	Trial 2	
Trial 1	Success	Failure
Success	3	0
Failure	4	13

Results and discussion

Looking at the successful completion of the four minute task, comparison between the first trial of Groups 8 and 9, respectively, reveals that under the conditions of control, subjects were less able to endure the Cold Pressor Test. Thus, whereas in Group 8 (control) only three out of 21 subjects (i.e., 14.3%) were able to complete the task, under the no control conditions of Group 9, eight out of 21 (38.1%) were able to do so. This difference is significant at the $p < .05$ level. The within-subject comparisons reveal a similar picture: In group 8 the percentage of successful completion changed from 14.3% to 33.3%, when switching from the control to the no control condition ($T=2.17$, D.F.=20, $p < .05$). In Group 9, the design called for the opposite order, namely, from lack of control to control. The percentage of success dropped from 38.1% to 33.3%. Whereas this drop is not significant, it indicates a tendency towards the advantage of no control. Furthermore, in view of the fact that successful experience with the Cold Pressor Test usually leads to subsequent success on the second trial, this drop in successful performance may be viewed as more important than that indicated by the actual numbers.

Tables 8 and 9 present the distribution of successful completion of the task for each group separately.

Insert Tables 8 and 9 about here

Yet another analysis relates to the actual duration of endurance under the various conditions, taking into account those subjects that did not keep their hand in the ice-cold water for the full four minutes. Once again, in Group 8 the mean duration for the control condition was 94.2 seconds, and for the no control condition 132.8 seconds. ($T=2.55$, D.F.=19, $p < .05$). The means for Group 9 were 145.2 for the no control condition, and 130.5 for the control condition (N.S.). The particular design used in this study allows an additional comparison, namely, that of the difference in the endurance under the two conditions. A new variable was calculated by subtracting the duration of endurance on the second task from the duration of endurance on the first task. For Group 8 this new measure describes the advantages of control, and for Group 9 the advantages of lack of control. Table 10 presents the analysis of variance comparing the two groups on this difference measure.

Insert Table 10 about here

Table 9: Success and Failure by trials, Group 9.

	Trial 2	
Trial 1	Success	Failure
Success	6	2
Failure	1	11

Table 10: Analysis of variance of differential endurance,
Groups 8 & 9.

Group	Mean	SD	Source	SS	D.F.	F	Sig.
8	38.6	67.8	Between	28,335	1	6.1	P<.05
9	-14.7	68.6					

20

The analysis of variance indicates that the two groups are significantly different on this measure, demonstrating once more the advantages of the absence of control for endurance. The fact that for most of our subjects the no-control condition was easier, suggests that this particular type of stressor, calling for passive, rather than active coping, may be particularly vulnerable to the impact of control. Thus, it is conceivable, that giving the subjects the control over the duration of the stress, produces continuous self-monitoring of the pain. Subjects are continuously trying to measure their capacity to go on, and consequently are unable to distract their mind from the painful experience of the Cold Pressor Test. This explanation, must, however, be put to a much more stringent test, by comparing endurance with an essentially passive task with a more active one. We would then predict that when the task allows for active coping, control is more beneficial.

It is important to note that whereas most subjects endured the Cold Pressor Test better under the no control condition, for some of them there was no such difference, and a few actually performed better under the control conditions. It is obvious that in many military contexts it can be of use to know who are the soldiers that endure better under control conditions and who are those that do better under the no control condition. This finding thus opens a most intriguing and complex area of study of individual differences, an effort that calls for special research of its own.

Looking at the limited personality variables utilized in this research, it is important to note that locus of control, as measured by the Rotter Scale, was only mildly and not significantly correlated with actual behavioral locus of control. Thus, the paper and pencil test, while easy to use, has very little relevance to actual behavioral differences in this area.

FIELD EXPERIMENT

The contract for our research stipulates the advantages of pre-testing some of the laboratory findings in the context of field experiments. More specifically, the usage of soldiers as subjects can significantly facilitate the translation of our data into the pragmatic military domain. Considering the fact that the ideas for the experimental work actually stemmed from the field, such a continuous interchange between laboratory and field research may clearly increase the value of our research. At the same time, however, the preliminary status of the field experiment cannot be overstated. It is only after accomplishing the entire spectrum of our tasks, that a more solid translation into the field could be expected.

The particular field experiment described here was carried out during the intensive training period of a highly selected, highly motivated group of soldiers, who were candidates to join a prestigious unit. It consisted of two parts:

In the first part, 40 soldiers were divided into two groups of 20 each, that were about to embark on a 40 kilometer march. The full information group was told explicitly that the distance consisted of 40 kilometers, and they were further kept informed during the march itself. The second group, the no information group, did not receive any information whatsoever, either prior to the beginning of the march or during the march proper.

The march itself took place under extremely inclement weather. It started during the night when it was very windy, pouring rain, and some hail. Each soldier carried 30 kilograms of equipment, and their route included a very steep climb. Needless to say, both groups marched on the same night, with only a small distance between them, to ensure that there will be no communication between the two groups. Several officers accompanied each group, and kept continuous observation of the individual performance of all soldiers. These observations were subsequently translated into a regular performance report at the termination of the march.

Given the high motivation and excellent physical shape of the participants, it came as no surprise that with the exception of one soldier, all were able to finish the march successfully. In the "no information" group, there was one soldier who broke down under the strain. At the same time, however, the performance reports of the officers indicated a major difference between the two groups. Thus, morale was significantly lower in the "no information" group, as was mutual assistance among the soldiers. There were also more unauthorized stops during the march itself. At the end of the march, the soldiers were asked how difficult it was, and subjects in the "no information" condition reported a much higher level of subjective stress than those in the "full information" condition. These results are in line with the experimental evidence coming from the laboratory, and encourage the attempt to generalize from one domain to the other.

There is, however, a continuation to the experiment, which turns it into a much more interesting study. One month after the initial march, the same soldiers had to go on a second 40 kilometer march. By now there were only 18 of the original 40 left in the training, thus drastically reducing the sample size. These subjects could be viewed as highly selected for physical and mental endurance. Once again it was a night march in very bad weather, with 30 kilograms of equipment. This time, however, the groups were

not divided into two, but all subjects were told that this was going to be a 60 kilometer march. The plan was to observe the impact of initially discouraging information with subsequent correction en route. During a major rest period which took place at the 23rd kilometer, the commander of the march asked all those who cannot go on to step forward in order to be collected by a command car. Six out of the 18 subjects did so. At this point, the psychologist accompanying the march intervened with the commander in charge and asked him to announce the actual distance right away. He then told the soldiers that instead of an additional 37 kilometers they have to go on for 17 kilometers only. Further, he asked all those who want to rejoin the march to do so. All six of the dropouts were able to join the group and finish the march in its entirety.

This experiment clearly illustrates the disadvantages as well as the advantages of a field study. Thus, it was originally planned to change the information only at the very last moment, namely, at the 39th kilometer, just before the end of the march. The fact that 33% of the soldiers were unable to go on, made it necessary to change the original plan, and provide the encouraging information when it was most needed. This improvisation, while reducing the "neatness" of a fully controlled experiment, is much more indicative of real-life situations.

As demonstrated one month before, all these soldiers had no problem in finishing a 40 kilometer march. At the same time, as long as they believed that it was a 60 kilometer distance, they were apparently psychologically and physically exhausted by this information. Once the change for the better was announced, all dropouts could mobilize sufficient energy to rejoin the ranks and finish the march successfully. These dramatic results indicate the potential usefulness of information management as a tool for enhancing endurance. Not only can the information produce fatigue, but it can also reduce it rather quickly. The high cost effectiveness of such manipulations warrants further in-depth research of the parameters involved. It is anticipated that experiments carried out during the third year of this study will provide additional important information pertaining to this set of issues.

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